PHYSICS (OPTICS)
UNIT-2

B.SC (IV-Sem)
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TITLE :- USES OF MICHELSON'S INTEROFEROMETER

There are mainly two uses of Michleson's interferometer as
(i) measure of the wavelength of monochromatic li[ght]
(ii) determine the refractive index or the thickness of thin transparent flim.

(i) Measure the wavelength of monochromatic light :-

Let us suppose that the interferometer is adjusted for circular fringes and a bright spot is obtained at the centre of the field of view. If d be the thickness of the air-flim enclosed between M_1 and M_2' and n the order of the spot obtained, we have

$$2d\cos\theta = n\lambda$$

But at the centre $\theta = 0$, so that $\cos\theta = 1$ Therefore

$$2d = n\lambda \quad \text{—— (1)}$$

if now M_1 be moved away from M_2' by $\lambda/2$, the 2d increase by λ.
Therefore (n+1) replaces n in equation (1). Hence (n+1)st bright spot now appears at the centre. Thus each time M_1 moves through a distance $\lambda/2$ next bright spot appears at the centre.
Let us suppose the during the movement of M_1 through a distance x, N new fringes appear at at the centre of the field. Then we have

$$x = N\lambda/2$$

$$\lambda = \frac{2x}{N} \quad \text{—— (2)}$$

Thus measuring the distance x with the micrometer screw and counting the number of fringes N the value of λ can be calculated.

The determination of λ by this method is more accurate because x can be measured to an accuracy of 10^{-4} and the value of N can be differentially increased as the circular fringes can be obtained upto large path difference.

(ii) Determination of thickness (or refractive index) of a thin plate.

The interferometer is adjusted to produce straight white light fringes and the cross-wise is set on the achromatic fringes which is perfectly straight. The straight given plate is now inserted in the path of one of the interferring waves. This increase the optical path of the beam by $(\mu-1)t$ where μ is the refractive index and t the ~~increase~~ thickness of the plate. Since the beam transverse the plate wise an extra phath difference of $(\mu-1)t$ is introduce between the two interfering beams. The fringes are therefore shifted. The movable mirror M_1 is moved till the fringes are brought back to their initial position so that the achromatic fringes are coincides with cross wise. If displacement of M_1 is x, then

$$2x = 2(\mu-1)t$$

or $$x = (\mu-1)t$$

Thus measuring x, t may be calculated if μ is known or μ may be calculated if t is known.

This method can be used to find the refractive index of a gas.

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